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making some experiments at Greenwich, it became clear that the zenith-distances were always given too great by about 4″. The cause of this anomaly is not known. On applying the corresponding correction, the results were made harmonious. It is remarked, however, that very little depended on this correction, the observations having been well balanced on the East and West sides of the meridian.

The signal-observations were then discussed nearly in the same way as in the determination of the longitude of Brussels (*Mem. Roy. Ast. Soc.*, vol. xxiv.), and the results were the following:—

	m	s
Time occupied in the passage of the current	0	0·129
Longitude of the Knightstown Station	41	9·81

By the kindness of Captain Clarke a geodetic connexion was made between the Feagh Main Station and the Knightstown Station, and their geodetic difference of longitude was found to be 13ˢ·56. Applying this to the former determination for Feagh Main, it is found that the old operations would have given for Knightstown 41ᵐ 9ˢ·67. The agreement of this with that found from the galvanic operation is very remarkable, and it proves that implicit confidence may be placed in the old determinations for Liverpool and Knightstown.

On the Movement of the Solar System in Space, deduced from the Proper Motions of 1167 *Stars.* By Edwin Dunkin, Esq., of the Royal Observatory, Greenwich.—(Abstract.)

The investigation which forms the subject of this Memoir, may be considered as a supplement or addendum to that of the Astronomer Royal, *On the Movement of the Solar System in Space*, published in vol. xxviii. of the Society's *Memoirs*. The method of calculation differs in no respect from that previously used, excepting that the Proper Motions of a much greater number of stars have been combined in producing the results. It is intended, therefore, that this paper should be read in connexion with the memoir of Mr. Airy, as the mathematical explanation, which has been given in detail by him, is not generally repeated on this occasion.

In this memoir, the Proper Motions of nearly all the stars contained in the Catalogues of the Rev. R. Main, have been adopted, numbering in all 1167 stars. In Right Ascension they are scattered in nearly equal proportions over the twenty-four

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hours, and in Declination, about two-thirds are situated in the northern hemisphere. The stars are arranged into groups or divisions, according to magnitude, in conformity with the researches of W. Struve, whose value of r has been adopted. The number of stars included in each division, and Struve's value of r, are as follows:—

Division.	Magnitude.			Value of r.	Number of stars in each Division.
1		1		1·00	9
2	1,2	2	2,3	1·71	55
3	3,2	3	3,4	2·57	146
4	4,3	4	4,5	3·76	238
5	5,4	5	5,6	5·44	330
6	6,5	6	6,7	7·86	368
7	7,6	7	7,8 8	11·34	21

The method which the Astronomer-Royal has proposed for determining the direction of solar motion, as being entirely free from the objections attaching to those of former investigations, "and, indeed, unobjectionable on the score of accuracy, consists merely in removing the primary geometrical notions from the apparent movements of the bodies in space. It is the obvious and simple method of treating the linear movements of the Sun, and of each star, by the use of rectangular co-ordinates. This method is in itself absolutely independent and complete, and requires no assumption of a point determined by preceding investigation."

For convenience of reference, the final symbolical equations from which the different numerical equations are immediately derived on two extreme suppositions, are inserted in the memoir. For the first supposition, it is assumed that the irregularities of Proper Motion are due to chance-error of observation; while in the second supposition they are considered to be entirely due to a peculiar motion of the stars.

The numerical equations for X, Y, Z, have been formed for each division on both suppositions, $-X$ representing the annual linear motion of the Sun in the direction of the first point of *Aries*, $-Y$ the motion in the plane of the equator towards that point whose right ascension is ninety degrees, and $-Z$ the motion towards the north pole of the equator. The solution of the sums of these equations gives the following values, neglecting very small terms depending on n' and q.

On the first supposition:

$$X = +0{\cdot}0428 + 1{\cdot}2349 \times n'$$
$$Y = +0{\cdot}2776$$
$$Z = -0{\cdot}1818 + 3{\cdot}5792 \times q$$

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On the second supposition:

$$\begin{aligned} X &= +0{\cdot}0406 + 2{\cdot}3747 \times n' \\ Y &= +0{\cdot}3696 \\ Z &= -0{\cdot}1735 + 6{\cdot}1090 \times q. \end{aligned}$$

From the above the following expressions are deduced:—

On the first supposition:

$$\begin{aligned} R &= 0{\cdot}3346 \quad + 0{\cdot}1580 \times n' - 1{\cdot}945 \times q \\ A &= 261^{\circ}\ 14'\ 0 - 4{\cdot}3454 \times n' \\ &= 261\ \ 14\ \ 0 - 248^{\circ}{\cdot}97 \times n' \\ D &= +32\ \ 55\ \ 0 - 0{\cdot}3057 \times n' - 8{\cdot}9811 \times q \\ &= +32\ \ 55\ \ 0 - 17^{\circ}{\cdot}52 \times n' - 524^{\circ}{\cdot}54 \times q \end{aligned}$$

On the second supposition:

$$\begin{aligned} R &= 0{\cdot}4103 \quad + 0{\cdot}2350 \times n' - 2{\cdot}5826 \times q \\ A &= 263^{\circ}\ 43'\ 9 - 6{\cdot}3480 \times n' \\ &= 263\ \ 43\ \ 9 - 363^{\circ}{\cdot}71 \times n' \\ D &= +25\ \ \ 0\ \ 5 - 0{\cdot}2672 \times n' - 13{\cdot}4937 \times q \\ &= +25\ \ \ 0\ \ 5 - 15^{\circ}{\cdot}31' \times n' - 773^{\circ}{\cdot}13 \times q. \end{aligned}$$

The preceding results have all been reduced, on the assumption that the distance of the stars varies inversely to their magnitude, regardless of the amount of Proper Motion. It is by no means improbable, however, that the few stars of the fourth, fifth, and sixth magnitudes, whose Proper Motions are extravagantly large, are really near stars, and as such might be placed with propriety in the first division. The results of a transfer of this kind, in addition to others of a similar nature, are given in the memoir. A glance at the values of X, Y, Z, determined by these different assumptions, shows distinctly that they are not relatively improved by any deviation from Struve's law of the mean distances of the different groups of stars with respect to these exceptional stars.

The value of R, or the Sun's proper motion as viewed from a star of the first magnitude, expressed in seconds, resulting from this investigation, differs very slightly from that determined by M. Otto Struve. His value is 0·3392. There is very little doubt, therefore, that a value near the mean of these numbers may be assumed as fairly representing the annual motion of the Sun and solar system towards the point to which the direction is assigned, so far as any result can be obtained by the use of the known apparent proper motions of the stars.

To show the numerical evidence of the probability that the values previously given should in some measure represent the motion of the solar system, the sums of the squares of the observed Proper Motions in Parallel and North Polar Distance

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were formed, and these have been compared with the squares of the residual errors after the corrections depending on solar motion have been applied. This comparison was only made on the second supposition. The results are exhibited in the memoir for each division; the total sums of the squares are as follows:—

Sum of squares of Motion in Parallel	Uncorrected	= 78·7583
	Corrected	= 75·5831
Sum of squares of Motion in N.P.D.	Uncorrected	= 63·2668
	Corrected	= 60·9084

"The reader must draw his own conclusions on the comparison of the uncorrected and corrected results given above. It appears to me that our fundamental suppositions rest altogether on a very slender basis; and the results warrant the question whether we have much ground to infer that the Proper Motions of the stars are produced principally by the motion of the Sun and its system in space. It may be, and probably such an inference is partially true, that these apparent motions in the positions of the stars are due to some compound effect resulting from causes some of which have yet to be discovered; though it is very remarkable that different astronomers, with totally different methods of investigation, should, without exception, fix the point in the heavens to which the solar motion is directed, within a few degrees of each other."

The memoir concludes with a comparison of the position of this point as determined by different astronomers, from the date of Sir William Herschel's original paper in 1783, to the present time. The author remarks on the extraordinary agreement of these researches:—"To say the least, this confirmation of result after result, would seem to show that the Proper Motions of the stars *must* be connected with the motion of the Sun in the direction of the point in the heavens indicated above. But the further consideration of this I must leave for others, merely remarking, that the grounds upon which we have been working are uncertain to a considerable extent, which uncertainty will scarcely be removed until our knowledge of the distances of the stars is increased, or until the Proper Motions themselves are re-determined from unexceptionable observations, made at both epochs, with the improved instruments of modern Observatories."

A table is appended to the memoir, containing the principal elements from which the numerical co-efficients have been computed. The stars are arranged in their respective divisions, in order of Right Ascension, excepting that all stars of North Declination are grouped together, the same being also done for stars of South Declination.